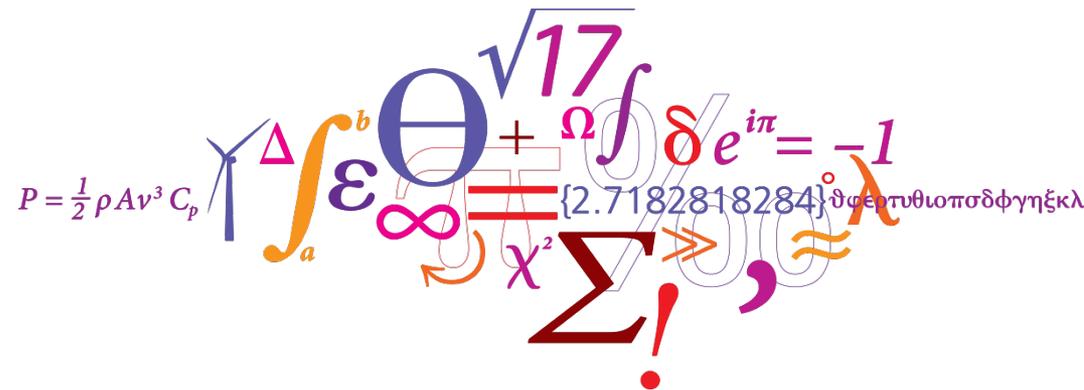


Analysis of Wind Turbine Loading during Short-term Overproduction

Müfit Altin, Athanasios Barlas, Anca D. Hansen

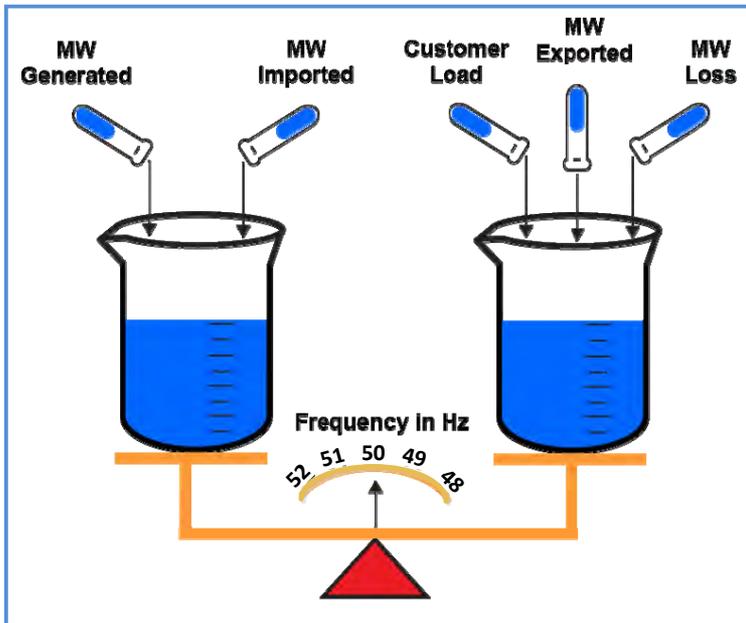
29/06/2017



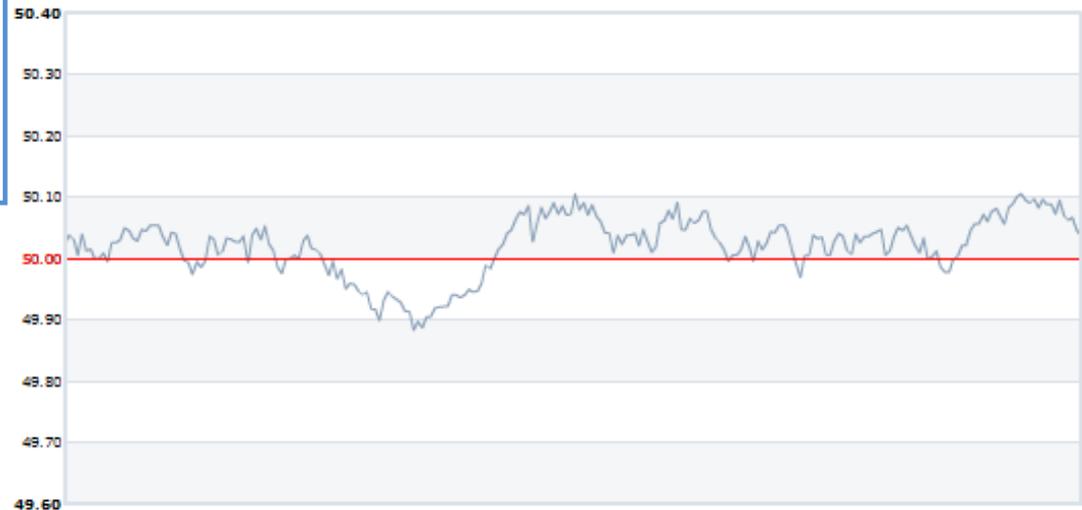
Outline

- What is Synthetic Inertia?
- Short-term Overproduction for Synthetic Inertia
- Impact of Short-term Overproduction on Wind Turbine Loading
- Conclusion

Background



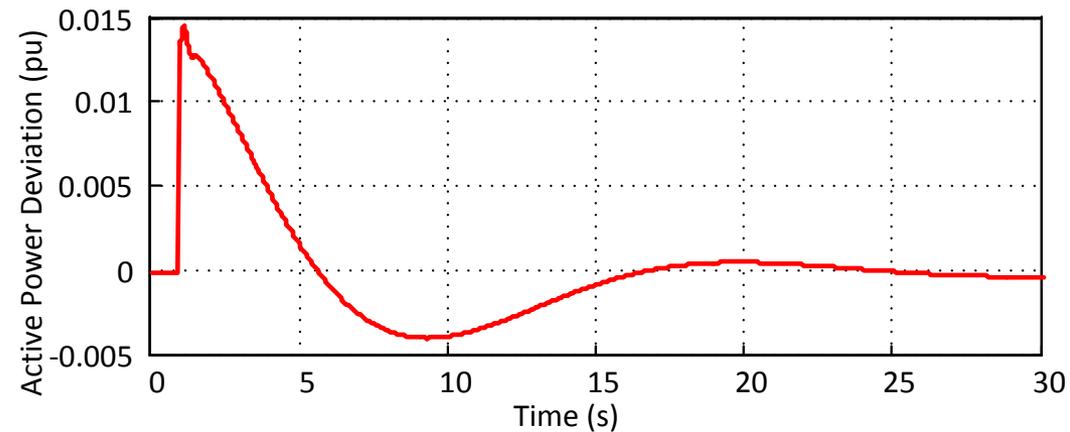
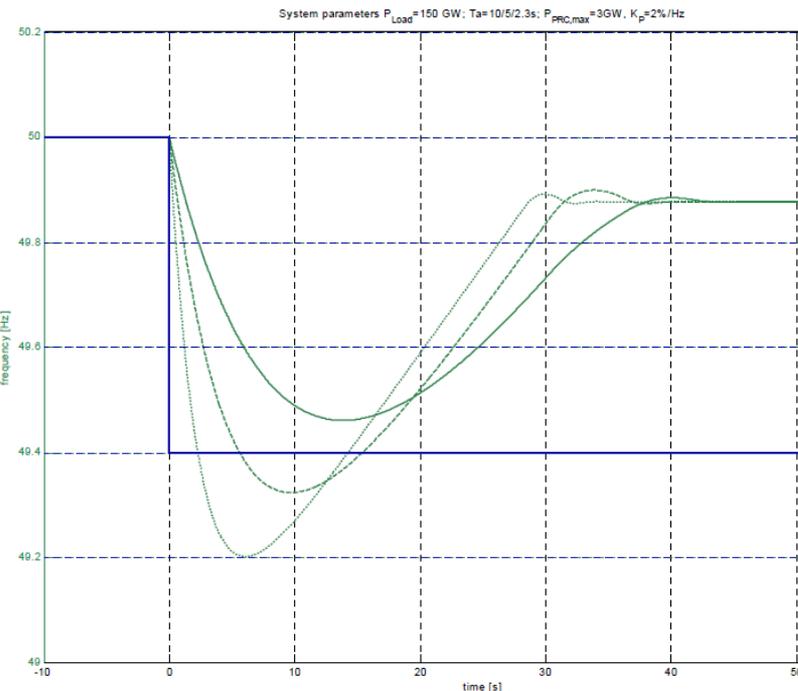
Frequency is the indicator for the balance between generation and consumption.



What is Synthetic Inertia?

'Synthetic Inertia' means the facility provided by a power park module or HVDC system to replace the effect of inertia of a synchronous power generating module to a prescribed level of performance.

**(ENTSO-E Network Code for Requirements for Grid Connection
Applicable to all Generators)**



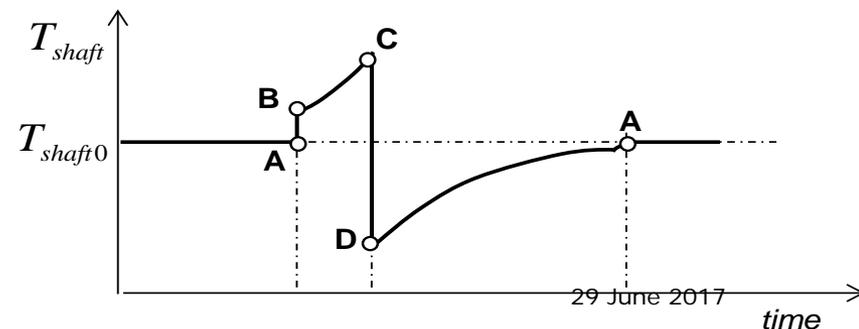
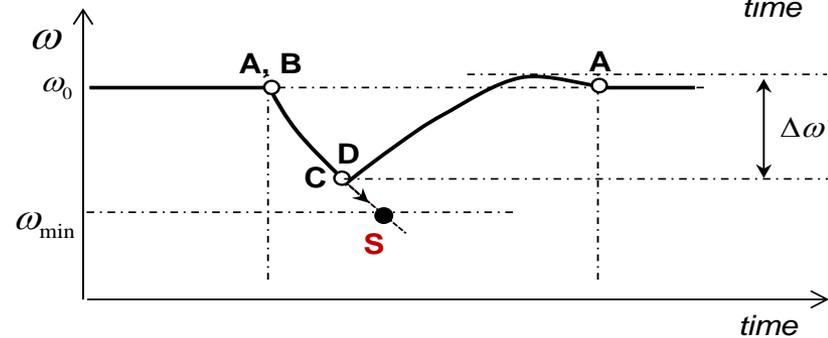
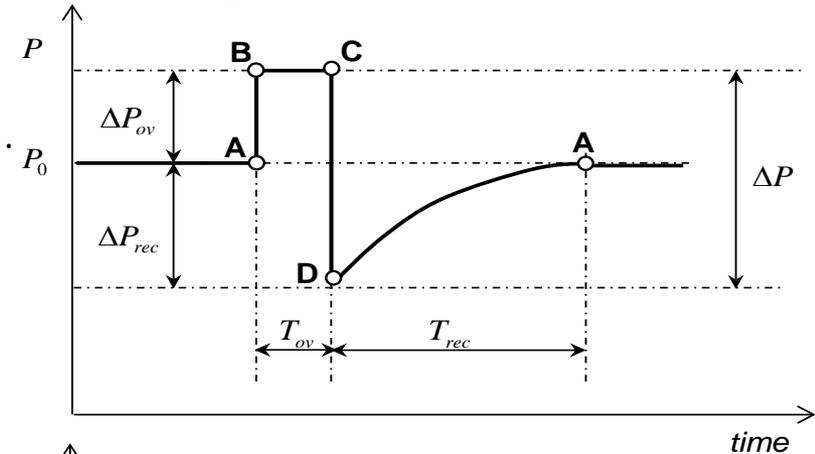
Short-term Overproduction for Synthetic Inertia

ΔP_{ov} is the overproduction active power step.

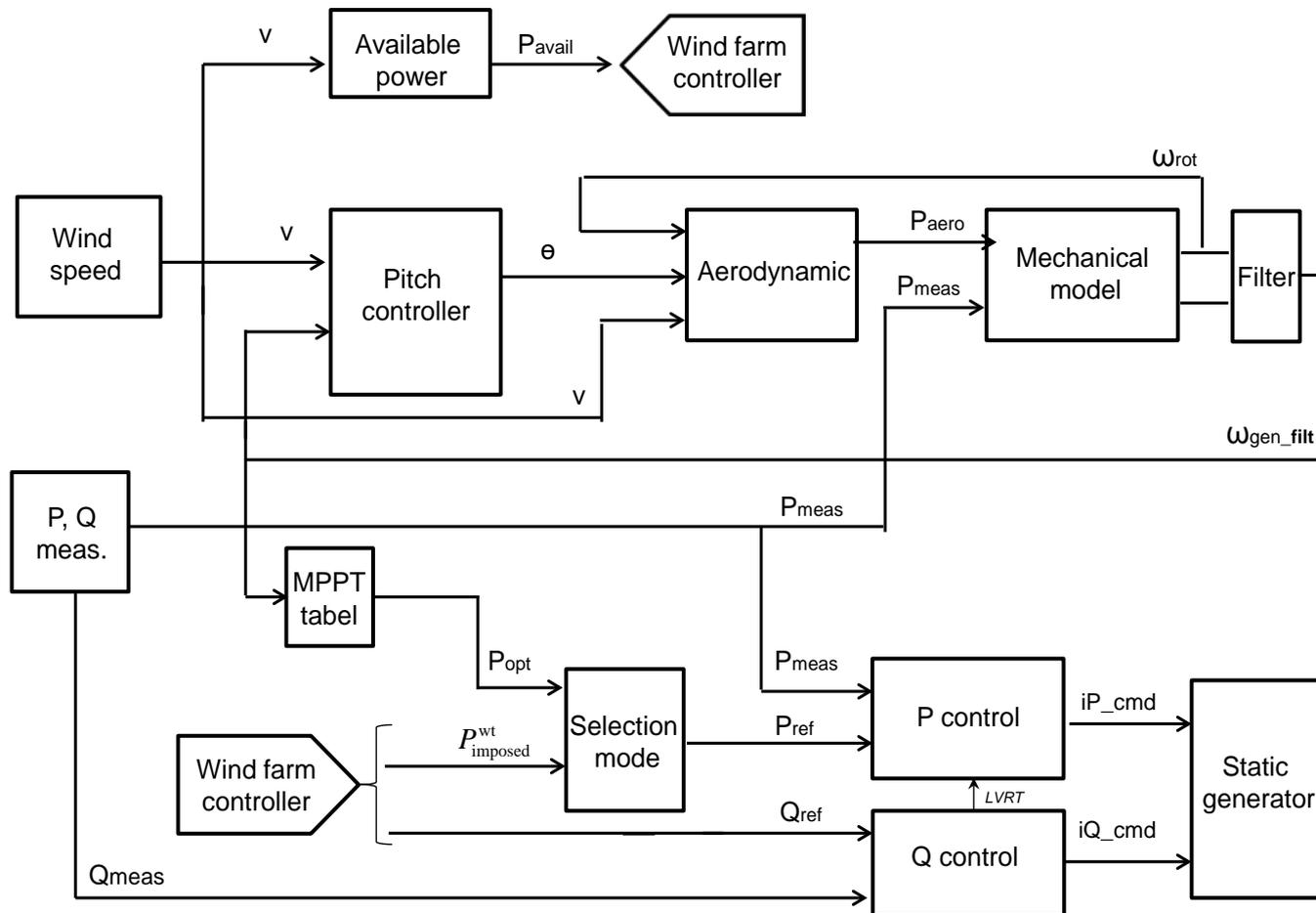
ΔP_{rec} is the drop of the power.

T_{ov} is the overproduction period.

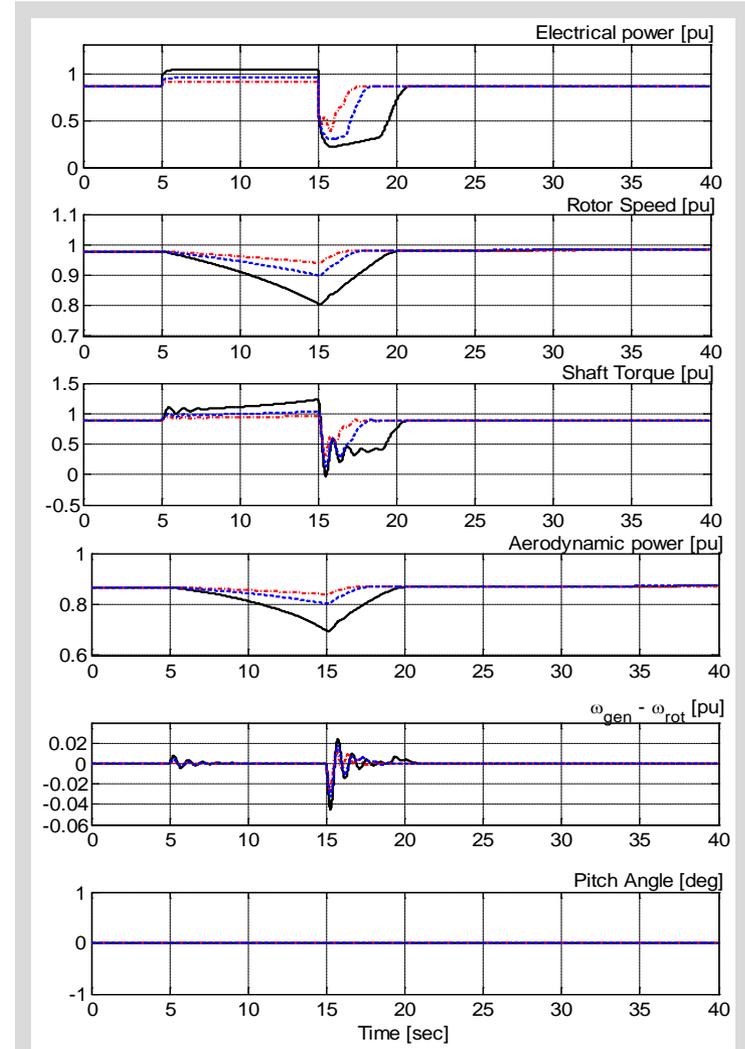
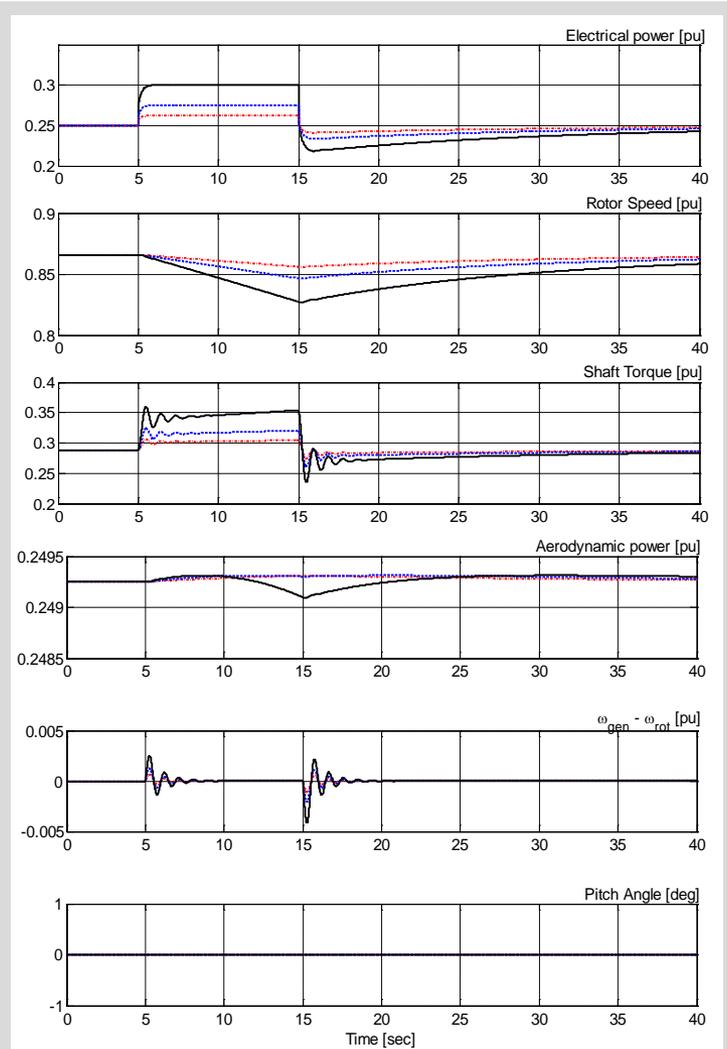
T_{rec} is known also as recovery period.



Dynamic Electrical Model



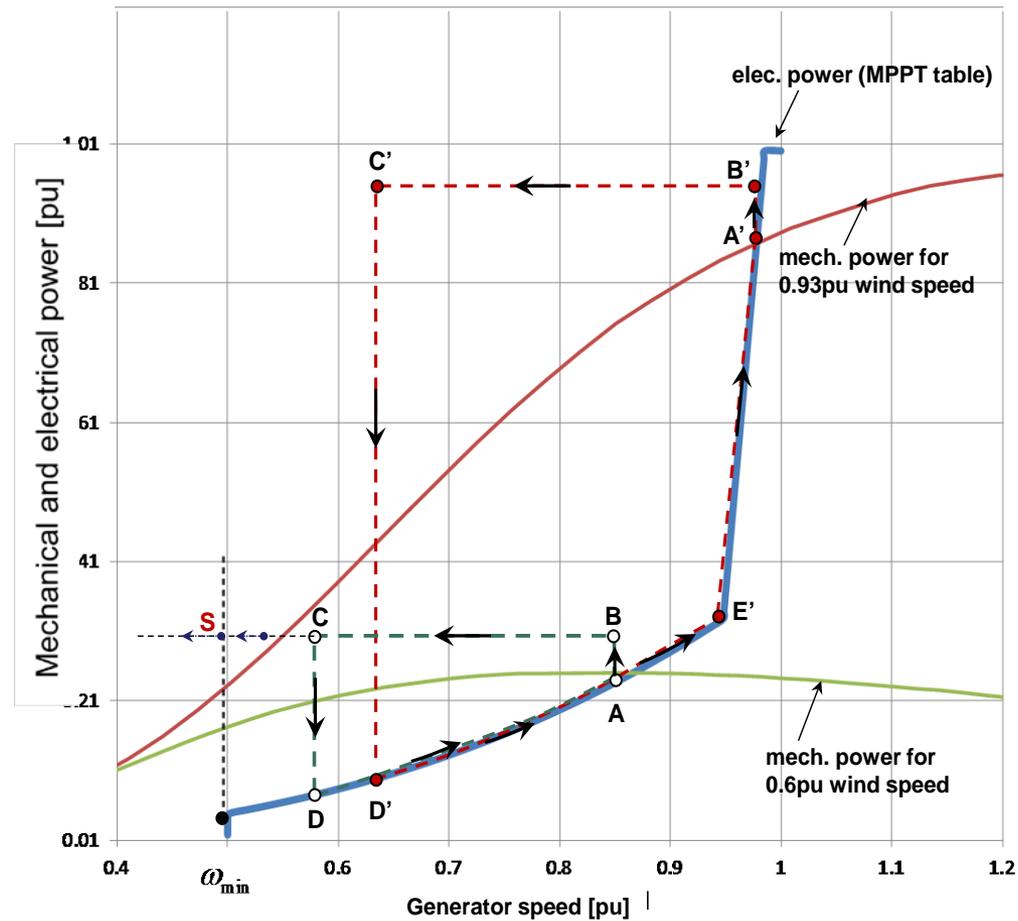
Short-term Overproduction Performance



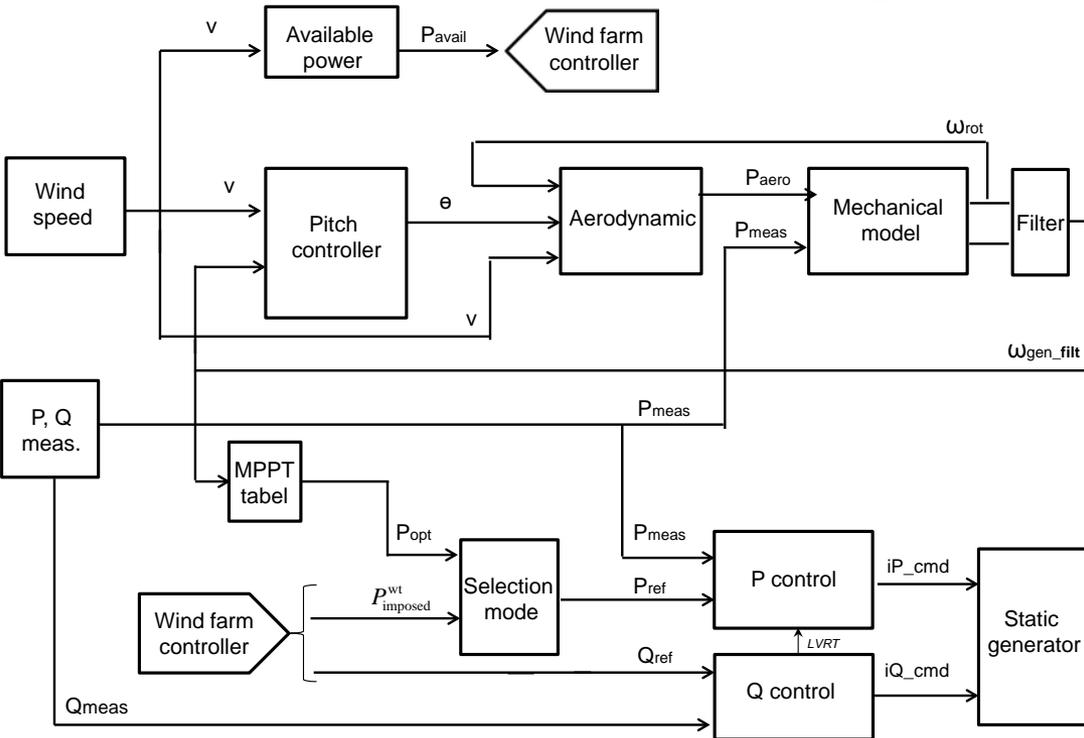
--- 5% Overproduction - - - 10% Overproduction — 20% Overproduction

--- 5% Overproduction - - - 10% Overproduction — 20% Overproduction

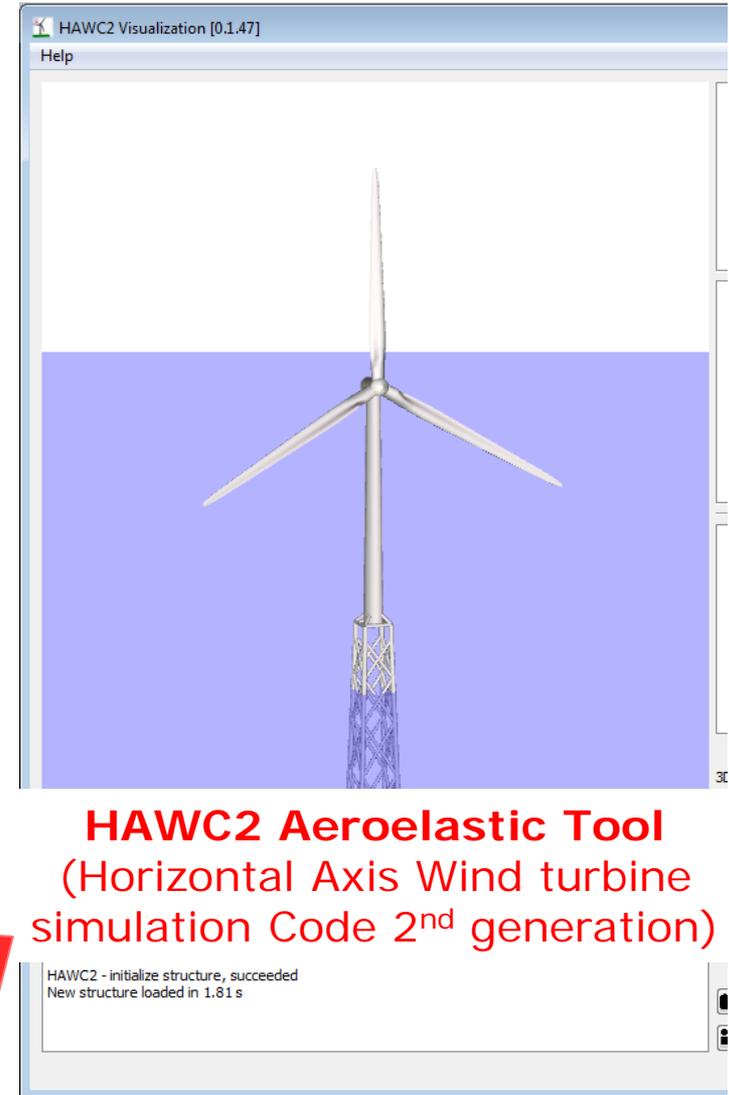
Short-term Overproduction Performance



Impact of Short-term Overproduction on Wind Turbine Loading



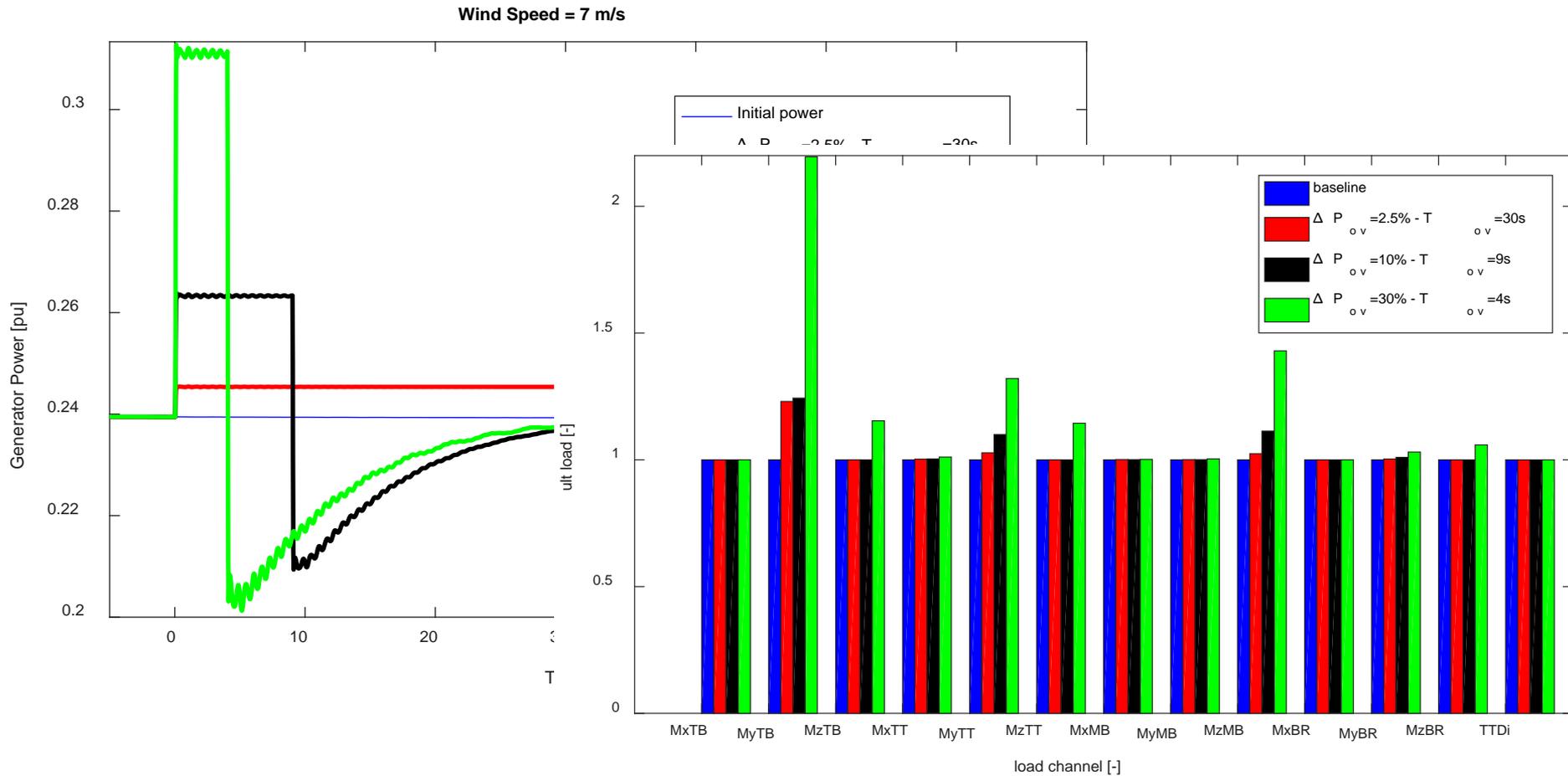
Electrical Model



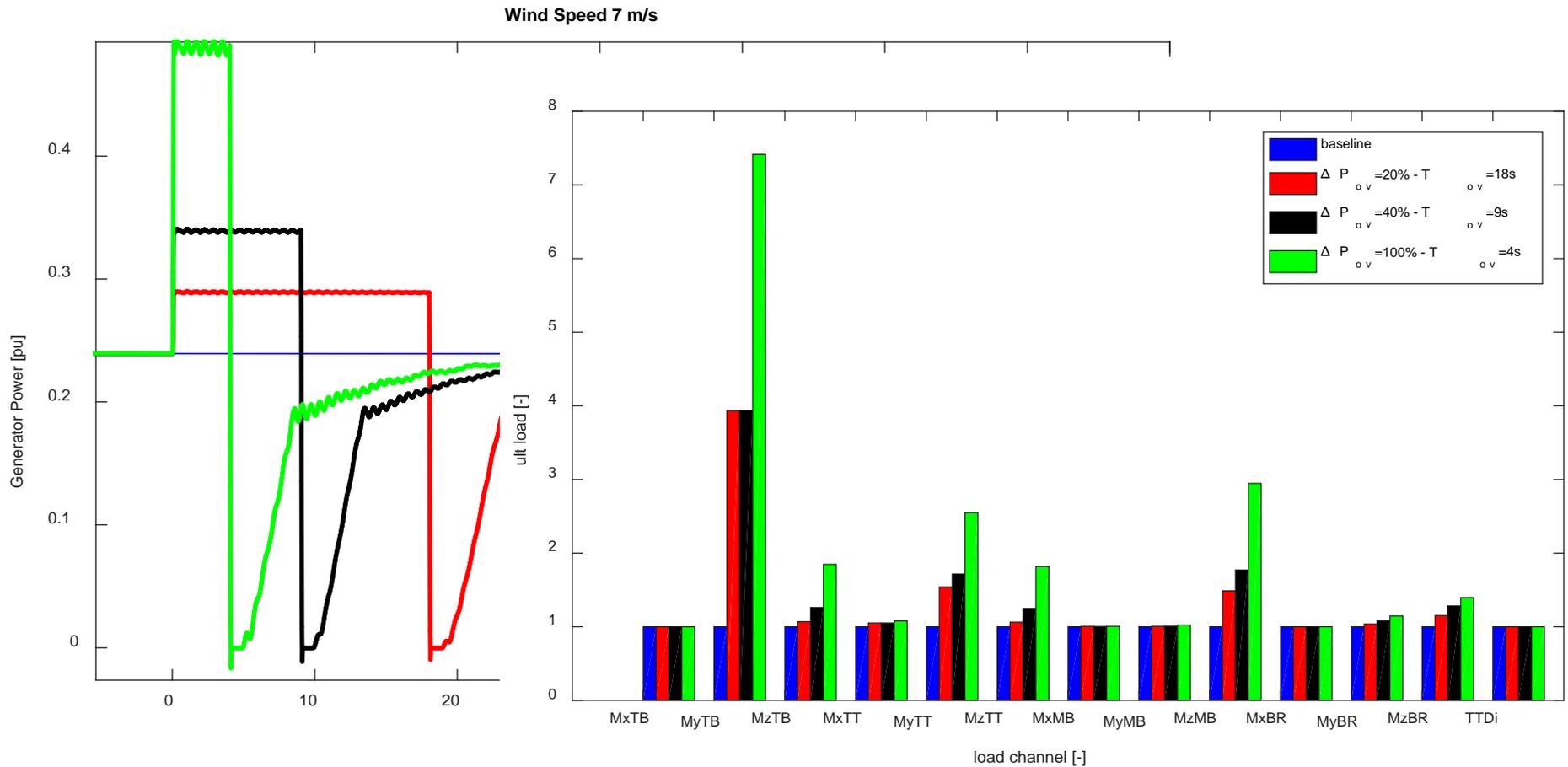
HAWC2 Aeroelastic Tool
(Horizontal Axis Wind turbine simulation Code 2nd generation)



Impact of Short-term Overproduction on Wind Turbine Loading



Impact of Short-term Overproduction on Wind Turbine Loading



Conclusion

- Synthetic inertia can be a future requirement from wind power plants.
- Ramp rates of active power control have a crucial impact on wind turbine loading (also on power system frequency profile)
- Grid code requirements can be tested with the same approach.
- Verification of electrical model with aerodynamic (HAWC2) model is needed in terms of active power and rotational speed deviations.